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Jesse U.S. PRO

## UTILITY

## PATENT APPLICATION

## TRANSMITTAL

(Submit an original, and a duplicate for fee processing)  
(Only for nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No:

W-9465-02

Page 1 of 3

First Named Inventor or Application Identifier

Georg Lüers

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Date Mailed: 4/11/00

## APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO:

Assistant Commissioner for Patents  
Box Patent Application  
Washington, DC 20231JES3015 S. PTO  
09/546735  
04/11/001. ☒ Fee :a. ☐ Separate Fee Transmittal Form Submittedb. ☐ See boxes 28-302. ☒ Specification

Total Pages

16

3. ☒ Drawing(s) (35 USC 113)

Total Sheets

7

4. ☐ Oath or Declarationa. ☐ Newly executed:i. ☐ Original for first filing of nonprovisional applicationii. ☐ Original for C-I-P applicationiii. ☐ Original for Continuation or Divisional application naming an inventor not named in prior application  
(37 CFR 1.63(d)(5))b. ☐ Copy from a prior application (37 CFR 1.63(d)) (for continuation/divisional with Box 19 completed):i. ☐ With no change of inventive entity in prior application neededii. ☐ With deletion of inventors requested at Box 27(a)(i)  
(37 CFR 1.48(b)) (see also 37 CFR 1.63(d)(2) and 1.33(b)).5. ☐ Incorporation By Reference (useable if Box 4b is checked)

The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.

6. ☐ Microfiche Computer Program (Appendix)7. ☐ Nucleotide and/or Amino Acid Sequence Submission (if applicable, all necessary)a. ☐ Computer Readable Copyb. ☐ Paper Copy (identical to computer copy)c. ☐ Statement verifying identity of above copies

## ACCOMPANYING APPLICATION PARTS

8. ☐ Assignment Papers (cover sheet & document(s))9. ☐ 37 CFR 3.73(b) Statement (to establish right of assignee to take action)10. ☐ Power of Attorney11. ☐ English Translation Document (if applicable)

12. ☐ Information Disclosure Statement (See 37 CFR 1.17(p) for fee)

a. ☐ Copies of IDS Citations

b. ☐ (IDS) / PTO-144913. ☐ Preliminary Amendment

14. ☒ Return Receipt Postcard (MPEP 503)(Should be specifically itemized)

15. ☐ Small Entity Statements:

a. ☐ A small entity statement is enclosed claiming small entity status

b. ☐ A small entity statement was filed in the prior nonprovisional application and such status is still proper and desired

16. ☒ Priority of ☒ U.S. provisional application Serial No. 60/129,007, filed on April 13, 1999 ☐ foreign application No. \_\_\_\_\_ filed on \_\_\_\_\_ in \_\_\_\_\_ (country), is claimed under 35 U.S.C. 119.

17. ☐ Certified Copy of Priority Document(s)(if foreign priority is claimed)

18. ☒ Other Documents Enclosed: Preliminary Amendment

**FOR A CONTINUING APPLICATION OR A 35 U.S.C. § 111(a) APPLICATION  
CLAIMING PRIORITY UNDER 111(b) PROVISIONAL APPLICATION**

19. Check appropriate box and supply the requisite information:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP)

20. ☐ Prior Application Information:

US Serial No.: \_\_\_\_\_, Filing Date:

Prior Application Examiner:

Prior Application Art Unit:

21. ☒ Cancel in this application original claims: 11-19 of the prior application before calculating the filing fee.  
(At least one original independent claim must be retained for filing purposes).

22. ☐ Amend the specification by inserting before the first line the sentence:

This is a ☐ continuation ☐ division of application Serial No. \_\_\_\_\_, filed \_\_\_\_\_.

23. ☒ Amend the specification by inserting before the first line the sentence: This application claims priority under 35 U.S.C. § 119 of the following provisional application Serial No(s). 60/129,007 and filing date(s) April 13, 1999.

24. ☐ New formal drawings are enclosed.

25. ☐ A certified copy of the priority application has been filed in prior application Serial No. \_\_\_\_\_, filed \_\_\_\_\_.

26. ☐ The prior application is assigned of record to: \_\_\_\_\_.

27. ☐ The Power of Attorney in the prior application is to:

a. ☐ The power appears in the original papers of the prior application.

b. ☐ Since the power does not appear in the original papers, a copy of the power in the prior application is enclosed.

**Inventorship Modifications For Continuation or Divisional Application**

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28. ☐ Change the inventorship of this application by:a. ☐ Deleting the following inventors named in the prior application (37 CFR 1.53(b)(1)):

\_\_\_\_\_, because claim changes resulted in fewer than all of the previously named inventors of the prior application being the actual inventors of the invention being currently claimed in this CPA application (This request constitutes a Petition in accordance with 37 CFR 1.48(b))(See Box 4(b)(ii) and 37 CFR 1.17(i) for fee);

**FEES**29. ☒ The filing fee is calculated below:**CLAIMS AS FILED, LESS ANY CLAIMS CANCELLED BY AMENDMENT BELOW**

For	Number Filed	Number Extra	Rate	TOTALS
Total Claims	24	4	\$18.00	\$72.00
Independent Claims	2	0	\$78.00	\$0.00
1st Time Multiple Dependent Claims (Yes=1 or No=0) =	0	0	\$260.00	\$0.00
BASIC FILING FEE			\$690.00	\$690.00
TOTAL FILING FEE DUE:				\$762.00
Other Fees				
Fee Type				Fee Amount
Total Fees				

30. ☒ Please charge \$832.00 to Deposit Account No. **07-1770**.  
Two additional copies of this form are enclosed.

31. ☒ The Commissioner is hereby authorized to charge any additional fees under 37 CFR 1.16 and 1.17 which may be required, or credit any overpayment to Deposit Account No. **07-1770**.  
Two additional copies of this form are enclosed.

**CORRESPONDENCE ADDRESS**32. ☒ Address all future communications to:

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Attorney or Agent

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☐ Attorney or agent of record  
☒ Filed under 37 CFR 1.34(a)

## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re U.S. Patent	:	April 11, 2000
Application For: A MATTING AGENT	:	
RADIATION FOR	:	
CURING COATINGS	:	
Inventors: Georg Lüers	:	
David J. Kent	:	
Dr. Volker Petry	:	
Ute Pospesch	:	Docket No.: W-9465-02

PRELIMINARY AMENDMENT

Honorable Commissioner of Patents and Trademarks  
Washington, D.C. 20231

Dear Sirs:

Please amend the above-identified patent application as indicated below. This Preliminary Amendment is filed concurrently with the Utility Patent Transmittal forwarding the above-identified application. As indicated in Box 21 of the Transmittal, it is requested that the filing fees be calculated on the basis of the amendments below. The application being filed concurrently herewith claims priority on U.S. Provisional Application 60/129,007 filed April 13, 1999.

In the Claims

As indicated in Box 21 of the the accompanying Utility Patent Transmittal, please cancel claims 11-19 and replace them with the following new claims.

20. A coating composition comprising a radiation curable component and a matting agent component, the matting agent component having a median particle size in the range of 2-12 microns, a wax content in the range of about 15 to 30% by weight of the total composition and a silica having a pore volume in the range of about 0.8 to 1.4 cc/g.

**CERTIFICATE OF MAILING UNDER 37 C.F.R. §1.8**

Pursuant to 37 CFR §1.8, I hereby certify that I have a reasonable basis to expect that this correspondence will be deposited with the United States Postal Service on or before the date indicated, as First Class mail, in an envelope addressed to: Commissioner of Patents and Trademarks, Washington, D.C. 20231.

4/11/00

Date

*Sean Shupps*

Signature

21. A coating composition according to claim 20 wherein the wax content is about 18-22% by weight.
22. A coating composition according to claim 20 wherein the wax has a melting point in the range of 60-120°C.
23. A coating composition according to claim 20 wherein the wax has a melting point in the range of 60-90°C.
24. A coating composition according to claim 20 wherein the median particle size of the matting agent component is about 2 to 5 microns.
25. A coating composition according to claim 20 wherein the silica has a pore volume in the range of about 0.9 to about 1.2 cc/g.
26. A coating composition according to claim 20 wherein the radiation curable component comprises acrylates.
27. A coating composition according to claim 20 wherein the radiation curable component is curable by exposure to ultraviolet radiation.
28. A coating composition according to claim 20 wherein the radiation curable component is curable by electron beam radiation.
29. A coating composition according to claim 20 further comprising a curing initiator.
30. A coating composition according to claim 20 wherein the radiation curable component comprises acrylate and the coating composition comprises 2% by weight or less of matting agent component.
31. A coated substrate comprising a substrate and a coating thereon prepared from a composition according to claim 20.

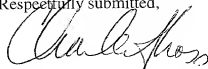
32. A coated substrate comprising a substrate and a coating thereto prepared from a composition of claim 30 and the coating has a matting efficiency of about 20 gloss units at 60°.

33. A coated substrate according to claim 32 wherein the coating comprises amine-modified polyether acrylate and is prepared from a composition comprising about 12% by weight matting agent component or less and the coating has a matting efficiency of about 60 gloss units or less at 60°.

Remarks

Claims 11-19 have been cancelled to remove multiple dependencies in the claims originally provided in U.S. Provisional Application 60/129,007.

Respectfully submitted,



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W-9465-02

A MATTING AGENT FOR RADIATION CURING COATINGS

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001140" 5E/94560

### Field of Invention

The invention relates to wax-coated, silica-matting agents and their application in the matting of radiation curable systems.

### Background To The Invention

As noted in WO97/08250, radiation curable, e.g., ultraviolet (UV) curable, compositions are used to coat a variety of surfaces. These compositions provide a number of advantages, of which include rapid curing, superior durability, chemical resistance and storage stability. However, they also result in relatively hard, smooth and glossy coatings. As these coatings become more widely used, there are more and more instances where it is preferable to reduce the gloss of these coatings. Reducing this gloss is also known as matting. Matted surfaces provide the finished articles with a more pleasing appearance, as well as hide imperfections at the surface, especially in wood, furniture, and several other applications.

Silica is one example of an additive used to matt glossy surfaces. Silica matting agents are used in both solvent and water based finishes to reduce or control gloss. However, lacquer systems with a low VOC content are becoming more and more important, due to national and international environmental and legislative pressures. Indeed, in some instances the VOC content in coatings is reduced to substantially zero, i.e., these coatings have a substantially 100% solids content. As a result, films prepared from these coatings may shrink by only 5 to 15% upon curing. This low shrinkage prevents conventional silica matting agents from efficiently matting at their conventional levels. For example, silica matting agents which work effectively in lacquer systems in which the film shrinks up to 70% as the film's solvent evaporates, are not able to matt high solids, radiation (EB, UV) curing systems efficiently. Specifically, the film thickness of a UV curable coating is not reduced to a point the silica particles can cause deformations on the film's surface.

In addition, a matting agent's effectiveness in radiation curable coatings is affected by the time necessary for curing the coating. Fast curing compositions are more difficult to matt using conventional agents. Today a wide range of radiation-curable lacquers are available. Most lacquers are based on combinations of acrylate functional prepolymers (oligimers) and monomers, together with photoinitiators in the



case of UV curing. The curing time of these systems is dependent on their composition and on the processing environment. Therefore, both the lack of film shrinkage and short curing time in certain radiation curable compositions (fractions of a second) hinders the efficacy of matting agents.

Special techniques such as "dual cure" methods have been used to matt UV curable systems. These techniques involve a two stage (hence "dual") cure process, designed to encourage the formation of a microrough surface, either through improved orientation of the matting agent particles towards the film surface or through surface wrinkling. An example of the former is "Gradient Intensity Cure" process involving a pregelling cure stage followed by a final surface cure stage. These techniques have the disadvantages of requiring specially designed equipment and formulations, as well as being notoriously difficult to control.

Another technique to reduce gloss in these coatings is to use higher levels of matting agents. However, high dosages of silica matting agent increases cost and also has a negative impact on lacquer properties, e.g., rheology or optical properties of the cured film.

The pore volume of the matting agents can be modified to reduce effects on rheology. However, lowering the pore volume of conventional micronized amorphous silica agents results in particles of higher apparent density, which in turn results in fewer particles per unit volume in the lacquer formulation. Because the number of particles have a direct influence on matting efficiency, an amorphous silica matting agent with a low pore volume exhibits a lower matting effect than a matting agent with a higher pore volume of the same particle size distribution.

Coarser or larger particles could also increase the gloss reduction of the cured film. However, increasing the particle size of the micronised product can adversely increase the surface roughness of the lacquer film to an unacceptable degree.

It is also known that with increasing film thickness and using coating compositions having higher cure rates, matting becomes increasingly more difficult. In those situations, matting can be maintained to a certain extent by increasing the amounts of matting agent. Increasing the number of micronized particles, however, dramatically and adversely changes the rheological properties of the lacquer.

In summary, due to the fast curing of UV-systems and the difficulties of matting such systems, it has been a practice to choose a micronized matting agent with a mean particle size which is close to the thickness of the film after it cures. Accordingly, when one is using a particular coating, the matting agent that can be used is one that has a particle size close to the film thickness of the resulting coating.

It is therefore desirable to have a matting agent which is efficient in radiation curable coatings and can be used at relatively low levels so that viscosity of the formulation is not adversely affected. It is also desirable to have a matting agent that is efficient for fast and slow curing systems, thereby offering the user of the matting agent greater flexibility. In other words, it would be desirable to have available a matting agent that produces stable, reproducible low gloss coatings for a variety of coating formulations without the usual problems of unworkable viscosity increases, inconsistent gloss values at varying coating weight and avoids the use of special application techniques to reduce gloss. In addition, it is also desirable that the agent produces a consistent matting effect over a wide range of thicknesses.

#### SUMMARY OF THE INVENTION

The aforementioned objects are unexpectedly obtained by employing silica matting agents having a maximum pore volume of 1.4 ml/g and a wax content of at least 15% and maximum of 30 % by weight. The wax preferably has a melting point in the range of 60-120°C, and most preferably in the range of 60-90°C. The matting efficiency of the agent is also affected by the particle size of the invention. The invention has a median particle size in the range of 2.0-12.0  $\mu\text{m}$ , with a preferred range of 2.0-5.0  $\mu\text{m}$ . It is also unexpected that the matting agents having particles sizes in the lower part of above ranges can enhance matting efficiency further without significant adverse affects on the viscosity of the coating composition.

The wax coated silica-matting agents can be used with a variety of radiation curable compositions and can be manufactured by simultaneously melting and milling the wax and silica to the desired particle size. The milling process is preferably carried out in a fluid energy mill with an inlet temperature which is above the melting point of the used wax.

## BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates the invention and the influence particle size has on the matting efficiency in a radiation (ultraviolet, i.e., "UV") curable composition compared to another matting agent composition.

5        Figure 2 illustrates the invention and the influence wax content in the invention has on matting efficiency in a radiation curable composition compared to other matting agents.

Figure 3 illustrates the viscosity of radiation curable compositions containing the invention and comparison matting agents at various coating thicknesses.

10        Figure 4 illustrates the viscosity of a commercial radiation (UV) curable composition containing the invention and comparison matting agents over extended periods of time. These viscosity measurements over time reflect what is referenced herein as viscosity stability.

Figure 5 illustrates how pore volume in the matting agents of this invention and comparison matting agents influences matting efficiency in a radiation curable composition.

Figure 6 illustrates the matting efficiency of the invention and comparison matting agents in a specific radiation curable composition known as Ebecryl™ 270.

Figure 7 illustrates the matting efficiency of the invention and a comparison matting agent in a specific radiation curable composition known as Laromer PO83F.

## DETAILED DESCRIPTION

The silica used to prepare the invention can be that used to prepare conventional porous silica flatting agents, provided the silica has a pore volume in the range of 0.8 to 1.4 cc/g. The pore volume referred to herein is determined by nitrogen porosimetry, described later below.

Silica gels are preferred. Hydrogels, xerogels and aerogels are all suitable. The general procedure to prepare inorganic gels is by the acid neutralization of salt solutions of metals or metalloids, which, thereafter upon standing form hydrogels. The hydrogels must then be washed to remove the relatively high concentration of soluble salts. Treatment during this washing stage determines physical properties, such as porosity, of the final product. The techniques for obtaining those properties

are known. For example, final gel pore volumes and surface areas are dependent upon the pH and temperature of the wash solution, the rate of wash, the particle size of the hydrogel, and the duration of wash. Generally, pore volume can be limited by shortening the duration of the washing periods. However, the specific washing conditions can vary depending on the particular inorganic hydrogel used, and are not per se critical to the invention, provided that the aforementioned pore volumes are developed in the final gel. As mentioned above, those skilled in the art are familiar with these washing conditions and are readily able to determine suitable washing conditions in which to form the desired pore volumes for use in this invention. For example, silica gels washed at a starting pH of 3-5 at 50-90°C for 5-25 hours form gels (aerogels) having pore volumes in the aforementioned range.

Particularly suitable silicas include hydrogels used to make commercially available silica matting agents such as the Syloid® matting agents from Grace Davison.

Suitable waxes are those known to make wax coated matting agents. Wax is added to matting agents to enhance the matting agent's redispersibility in the event the matting agent settles during storage. Waxes having a melting point in the range of 60-120°C are preferred, with those having a melting temperature in the range of 60-90°C being most preferred. It is also preferable that the wax is an unbranched linear polyolefin and has an average molecular weight of about 1200 and more preferably 1000 or lower. Paraffin waxes are suitable, but other waxes such as polyethylene waxes are also suitable. WO97/03246 discloses specific examples. Other suitable waxes include Fischer-Tropsch wax commercially available as Vestowax™ grades.

The wax-containing matting agent of this invention can be prepared by conventional co-milling processes in which the wax is melted simultaneously with the comminution of the silica to the desired particle size of about 2 to 12 microns. Such a process is most effectively carried out in a fluid energy mill or microniser. The operating temperature can then be varied according to the requirements of the wax. The inlet temperature of the air being supplied to the fluid energy mill should at least be high enough to ensure the wax melts within the residence time profile of the milling equipment. The wax is added to the mill so that the final product has a wax content of 15 to 30% by weight.

The matting agent of the invention can be used with a variety of radiation curable compositions designed for coating substrates. The coating composition can be those cured by ultraviolet radiation and electron beam radiation.

Ultraviolet curable compositions generally comprise components containing unsaturated groups. Acrylate-containing compounds are typically used. Acrylate-based UV curable compositions generally comprise an acrylate-terminated oligimer combined with a lower molecular weight acrylate monomer, with the latter also referred to as a reactive diluent. Suitable oligimers are those derived from well known isocyanate, or epoxy-containing compounds, as well as those based on polyester, polyether or amino compounds.

The reactive diluent can be polyfunctional or monofunctional. Suitable polyfunctional acrylate reactive diluents include trimethylolpropane triacrylate, pentaerythritol triacrylate, hexanediol diacrylate, tripropyleneglycol diacrylate, and others. Suitable monofunctional acrylates include ethylhexyl acrylate, 2-Hydroxyethyl acrylate, ethoxyethoxyethyl acrylate, isobornyl acrylate, and 2-carboxyethyl acrylate.

The nature of the radiation curable coatings and their applications are known and described in Organic Coatings, Science and Technology, Volume 2, pp 253-272 (1994). As mentioned earlier the compositions that cure at faster rates are more difficult to matt, and in addition to showing superior efficiency in compositions which cure at lower rates, the invention provides relatively efficient matting in those compositions as well. The matting agents are added to the radiation curable compositions using standard techniques.

The paragraphs directly following describe the tests and formulations used to evaluate the invention.

A) Nitrogen surface area - pore volume

Nitrogen surface area is determined by standard nitrogen porosimetry adsorption methods of Brunauer, Emmett, and Teller (BET) using a multi point method with an ASAP 2400 apparatus by Micromeritics. The samples are degassed under vacuum @ 100°C for 12h. Surface area is calculated from the volume of nitrogen gas adsorbed at  $p/p_0$  0.967. This apparatus also provides the pore size distribution from which it is

possible to get the pore volume size ( $D_{10}$ ) for which of the pores are below this pore size. In the same manner, it is possible to get the pore size for which 50% ( $D_{50}$ ) and 90% ( $D_{90}$ ) of the pores are below this pore size. Additionally the pore volume (ml/g) for a given range of pore size can be obtained from the desorption curve.

5 B) Viscosity

Viscosity is measured by a Brookfield RVT DV2 Viscometer of the stock solution or by a Bohlin Rheometer VOR of a formulation to reach 30 units gloss. The formulation is allowed to deaerate for 24h before measurement.

10 C) Weight median particle size

The weight median particle size or "median particle size" referred to herein is determined with a Malvern Mastersizer using a 100-mm path length lens. This instrument uses the principle of Fraunhofer diffraction utilizing a low power He/Ne laser. Before measurement the samples were dispersed ultrasonically in water for 10 seconds to form an aqueous suspension. The Malvern Mastersizer measures the weight particle size distribution of the silica. The weight mean particle size ( $d_{50}$ ) the 10-percentile ( $d_{10}$ ) and the 98-percentile ( $d_{98}$ ) are easily obtained from the data generated by the instruments.

25 D) The carbon content of the coated silicas is determined by a LECO SC44. The carbon present is converted to carbon dioxide at high temperature using the induction furnace. The gas is then detected by an infrared detection system. The wax content (in % w/w) is calculated from the carbon level obtained.

25 E) Application tests were carried out in a "fast curing" (difficult-to-matt) system based on Laromer PO 83F from BASF, and a "slow" curing (easy-to-matt) system based on Ebecryl 270 from UCB. The photoinitiators used are benzophenones.

30 F) Gloss

Gloss and the matting effect inferred from using the invention was measured by DIN 67530, the contents of which are incorporated herein by reference.

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## G) Coating Formulations

**Laromer™ PO 83F (BASF):**

Compound		Quantity
1. Laromer PO 83F (amine modified polyether acrylate)		85.5 g
2. Irgacure™ 500		04.5 g
3. Matting Agent		10.0 g
Dispersed at 2000 rpm / 5 min; applied with 24µm K-Bar		
Curing:	Line speed 10m/min; Mercury lamp 120W; single pass	

5 **Ebecryl™ 270 (UCB):**

Compound		Quantity
1. Ebecryl 270 (urethane acrylate)		55.2 g
2. Tripropyleneglycol diacrylate (TPGDA) crosslinkers		128.8 g
⇒ 5 min mixing @ 2000 rpm		
3. Benzophenon		7.36 g
4. Irgacure 651 initiator		3.68 g
5. Matting Agent		8.0 g
Dispersed at 2000 rpm / 5 min; applied with 24µm K-Bar		
Curing:	Line speed 5m/min; Mercury lamp 120W; single pass	

The stock suspension was prepared by dispersing matting agent in the ready to use lacquer with a Dispermat VMA by Getzmann @ 2000 rpm for 10 minutes.

- 10 Matting curves are made by diluting the stock suspension to achieve 5 different matting agent concentrations. The matted lacquer is drawn down with a 25 µm K-Bar on coated test cards (Schwegmann).

Examples

Samples of wax-containing matting agents were prepared with an AFG 400 fluidized mill and an air inlet temperature of 190°C. The classifier speed and feed rate were set to achieve the appropriate particle size of the coated micronised product.

Wax coated silica having the following characteristics were produced. The abbreviations appearing in the Tables below are defined as follows:

APS – weight median particle size

PV – pore volume

SA – surface area

PE – polyethylene

COMP - comparison

Table 1

Matting Agent	PV [ml/g]	SA [m <sup>2</sup> /g]	APS [µm]	Wax Type	Wax Content
INVENTION	1.10	380	3.70	Fischer-Tropsch	20%
COMP 1	1.01	380	7.12	Fischer-Tropsch	10%
COMP 2	2.1	270	3.29	Fischer-Tropsch	20%
COMP 3	1.8	285	7.9	PE wax	12%

The matting agents described in Table 1, as well as a matting agent commercially available as Syloid® ED30, were formulated into two coating formulations. The properties of the formulations, along with matting agent properties are reported in Tables 2 and 3 below.



## 1. Matting Results in Ebecryl 270 (UCB):

Table 2

Matting Agent	APS [ $\mu\text{m}$ ]	PV [ml/g]	Wax Content	Rel. Viscosity of 8% Suspension	Matting efficiency @ 30 Gloss Units
INVENTION	3.70	1.10	20	1.52	0.54
COMP 1	7.12	1.10	10	2.50	1.26
COMP 2	3.29	2.1	20	1.55	0.84
COMP 3	7.9	1.8	12	3.37	1.00
SYLOID® ED30	6.5	1.8	10	4.41	1.06

5

## 2. Matting Results in Laromer PO 83F (BASF):

Table 3

Matting Agent	APS [ $\mu\text{m}$ ]	PV [ml/g]	Wax Content	Rel. Viscosity of 10% Suspension	Matting @ 60° of 10% Suspension
INVENTION	3.7	1.10	20	8.47	69
COMP 1	7.12	1.10	10	4.21	75
COMP 2	3.29	2.1	20	9.24	71
COMP 3	7.9	1.8	12	19.39	73
SYLOID® ED30	6.5	1.8	10	27.27	80

- The results in Table 2 indicate that when particle size and wax content are kept relatively constant, a matting agent having a pore volume in the range of the invention has better matting efficiency than a matting agent having a pore volume outside the range of the invention, e.g., 2.1 ml/g. Compare the invention with COMP2. This is also illustrated in Table 3 which shows matting and viscosity results from matting agents in the fast curing (difficult-to-matt) system containing Laromer PO 83F.
- Compare the invention with COMP2 in Table 3

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It has also be unexpectedly found that matting efficiency is enhanced when using matting agents having a smaller APS at the lower end of the particle size range claimed for this invention. See Figure 1, and compare COMP3 (having an APS of 7.9  $\mu\text{m}$ , PV of 1.85 ml/g and Wax content of 12%) and Invention 2 (APS=6.3  $\mu\text{m}$ , PV=1.01 ml/g, and Wax content of 20%) with Invention 1 (APS=3.4  $\mu\text{m}$ , PV=1.01 ml/g, and Wax content of 20%) and Invention 3 (APS=3.7  $\mu\text{m}$ , PV=1.01 ml/g, and Wax content of 20%).

Figure 2 shows that wax contents greater than 15% and preferably 20%, increases the gloss reduction of the cured film compared to conventional matting agents having wax contents less than 15% by weight. COMP 1 and COMP3 are defined earlier and Invention 2 comprising 20% by weight wax is defined above.

Figure 3 shows an unexpected effect that gloss is independent of film weight and that the invention can reduce gloss with increasing film weight. The first thirteen (13) samples from left to right in Figure 3 are commercially available matting agents. COMP3 and Invention 1 are defined above. The sample labelled Invention is defined in Tables 2 and 3 also above.

Figure 4 shows that coating compositions according to the invention have lower viscosity and that the viscosity is more stable over time compared to conventional matting agents. Without being held to any particular theory, it is believed that this effect is caused by the lower PV, higher SA and therefore better wax coating of the particles. This avoids particle interactions and increases the relative internal porosity. It is believed that the same reasons are responsible for the increased gloss stability of the new silica matting agent. Viscosity stability enables the lacquer formulator to use the lacquer after 24 h without further gloss fluctuations.

Figure 5 shows that matting agents having pore volumes according to the invention provide more efficient matting.

Figures 6 and 7 illustrate the matting efficiency of matting agents according to this invention in the two acrylate compositions illustrated above compared to conventional prior art matting agents.

What is claimed is:

1. A matting agent composition comprising silica and wax wherein the composition has a median particle size in the range of 2-12 microns, a wax content in the range of about 15 to 30% by weight of the total composition and the silica has a pore volume in the range of about 0.8 to 1.4 cc/g.

2. A matting agent composition according to claim 1 wherein the wax content is about 18-22% by weight.

3. A matting agent composition according to claim 1 wherein the wax has a melting point in the range of 60-120°C.

4. A matting agent composition according to claim 1 wherein the wax has a melting point in the range of 60-90°C.

5. A matting agent composition according to claim 3 wherein the wax is paraffin and has a melting point in the range of 60-90°C.

6. A matting agent composition according to claim 1 wherein the median particle size of the composition is about 2 to 5 microns.

7. A matting agent composition according to claim 2 wherein the median particle size of the composition is about 2 to 5 microns.

8. A matting agent composition according to claim 1 wherein the silica has a pore volume in the range of about 0.9 to about 1.2 cc/g.

9. A matting agent composition according to claim 2 wherein the silica has a pore volume in the range of about 0.9 to about 1.2 cc/g.

10. A matting agent composition according to claim 7 wherein the silica has a pore volume in the range of about 0.9 to about 1.2 cc/g.

11. A coating composition comprising a radiation curable component and  
5 a matting agent component according to any one of claims 1-10.

12. A coating composition according to claim 11 wherein the radiation curable component comprises acrylates.

10 13. A coating composition according to claim 11 wherein the radiation curable component is curable by exposure to ultraviolet radiation.

14. A coating composition according to claim 11 wherein the radiation curable component is curable by electron beam radiation.

15 15. A coating composition according to claim 13 or 14 further comprising a curing initiator.

16. A coating composition according to claim 13 wherein the radiation  
20 curable component comprises acrylate and the coating composition comprises 2% by weight or less of matting agent component.

17. A coated substrate comprising a substrate and a coating thereon prepared from a composition according to any one of claims 11-16.

25 18. A coated substrate according to claim 17 wherein the coating is prepared from the coating of claim 16 and the coating has a matting efficiency of about 20 gloss units at 60°.

30 19. A coated substrate according to claim 16 wherein the coating is prepared from an amine-modified polyether acrylate, the coating is prepared from a

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composition comprising about 12% by weight matting agent component or less and the coating has a matting efficiency of about 60 gloss units or less at 60°.

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**Abstract**

A matting agent composition comprises silica and wax wherein the composition has a median particle size in the range of about 2-12 microns, a wax  
5 content in the range of about 15-30 wt.% and the silica has a pore volume in the range of about 0.8 to 1.4 cc/g. The matting agent is particularly suitable for radiation curable coatings. The matting agent has been shown to be particularly efficient in such coatings, as well as shows consistent gloss over varying coat weights.

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Figure 1

001110.58/94560

Influence of Particle Size on Matting Efficiency in Ebecryl 270 (easy-to-matt)

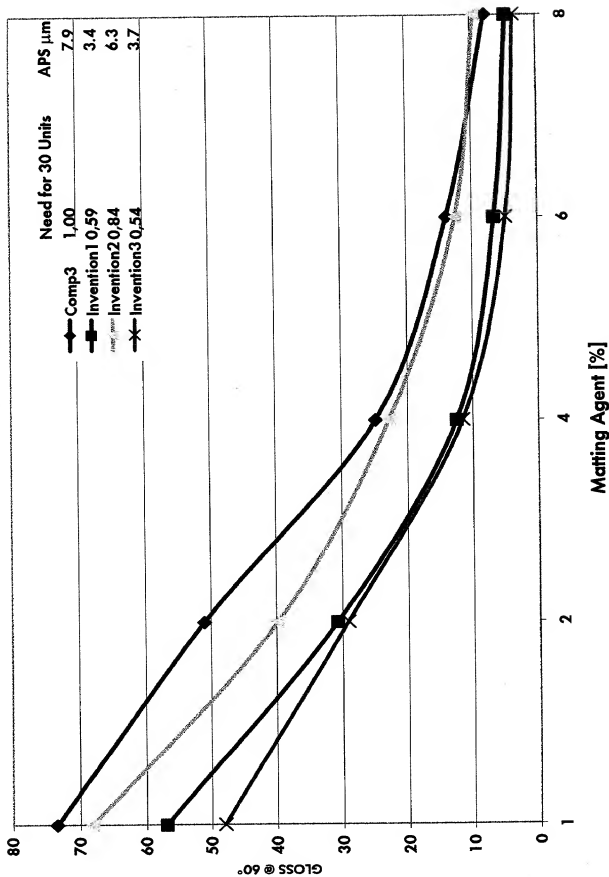
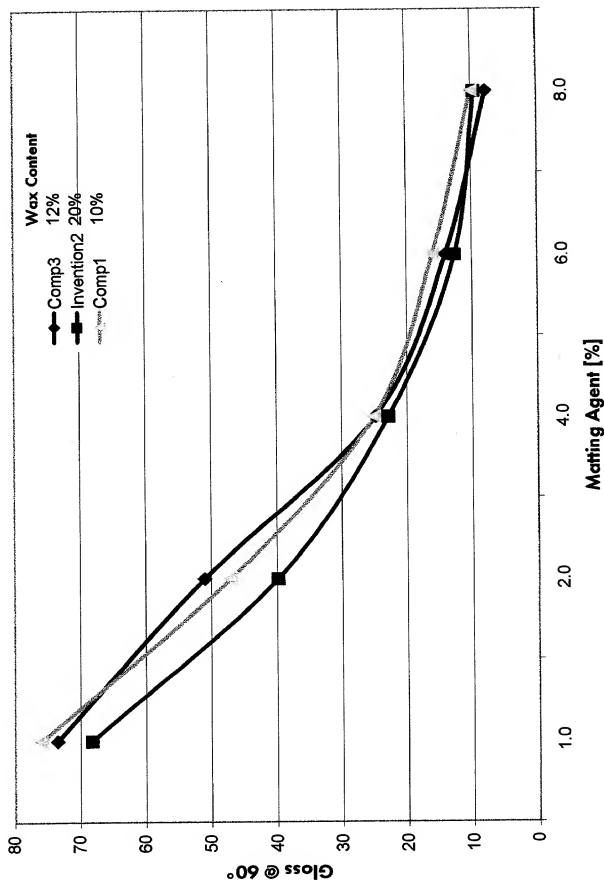


Figure 3-15-10

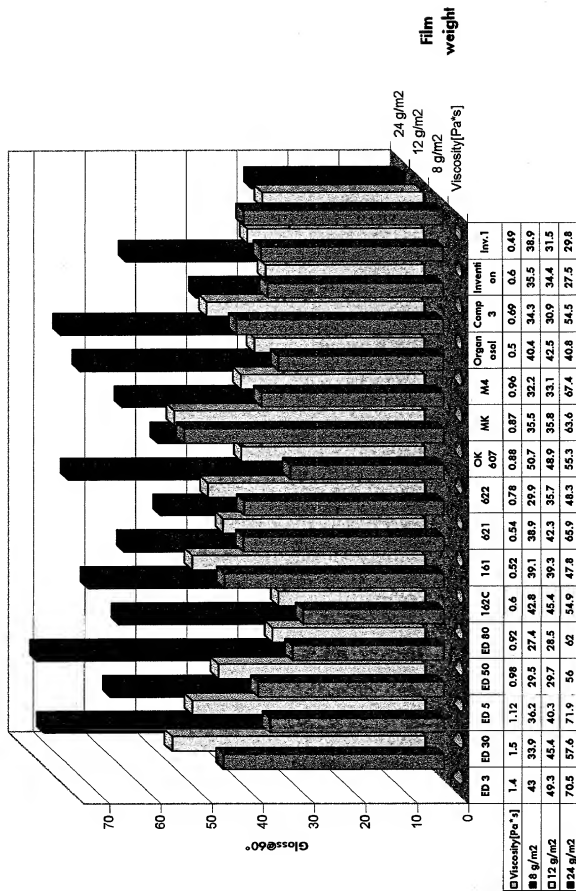
### Influence of Wax Content on Matting Efficiency in Ebecryl 270 (easy-to-matt)

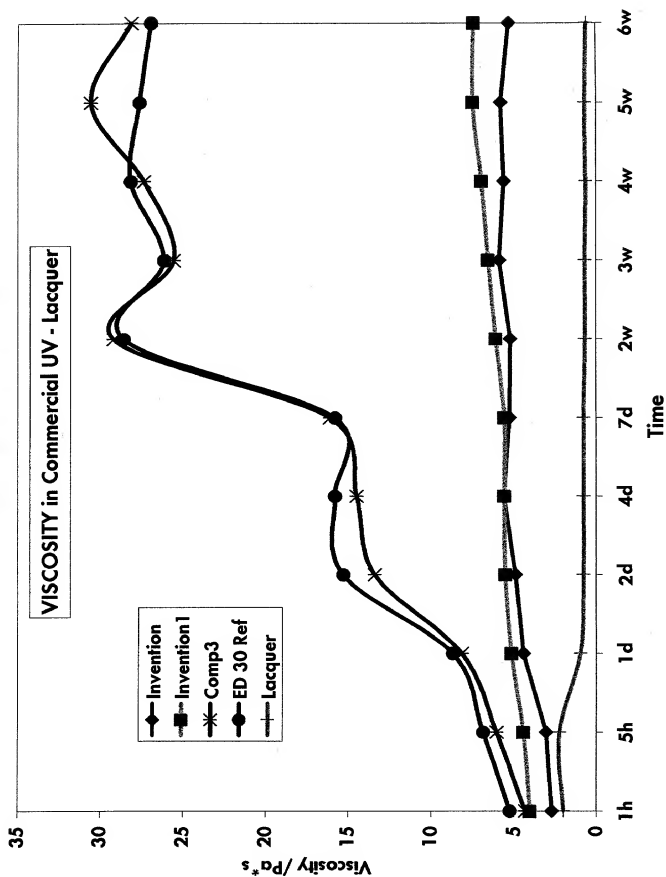




# *Comparison of different Mating Agents in Laromer PO 43F*

(20% O<sub>2</sub>, 160 W/cm<sup>2</sup>CK, 10m/min)





# Basegels with PV (0.4-2.1 ml/g) in Ebecryl 270

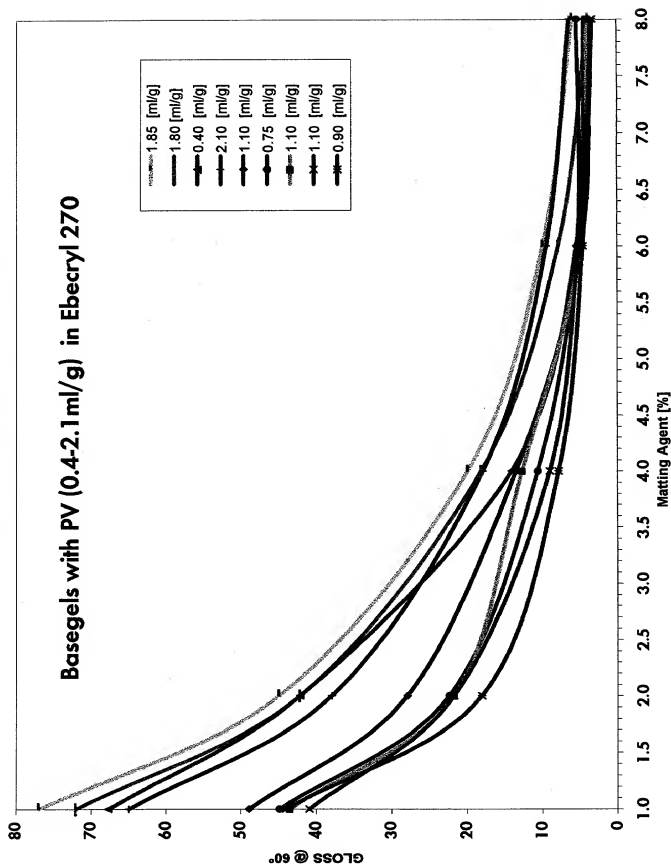


Figure 6

**Invention: Matting Efficiency in an "Easy-to-matt" UV  
Lacquer  
based on Ebecryl 270**

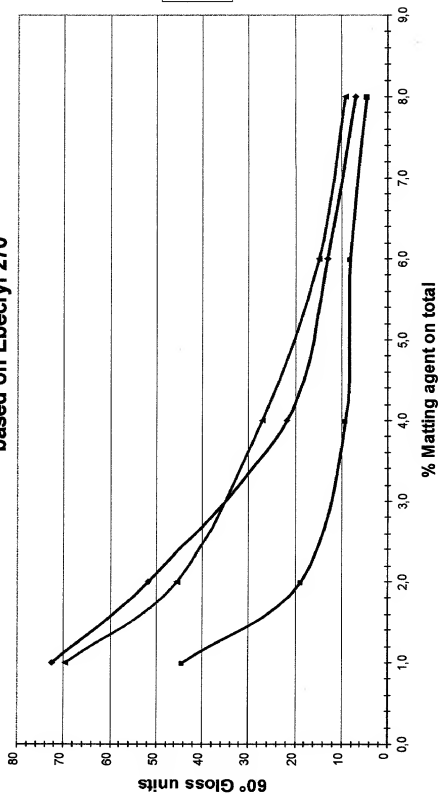


Figure 7

**Invention: Matting Efficiency in a "Difficult-to-matt"  
UV Lacquer  
based on Laromer PO83F**

